UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/292,186	04/15/1999	DANIEL M. KINZER	IR-1609-(2-1	3190

2352 7590 07/25/2003

OSTROLENK FABER GERB & SOFFEN
1180 AVENUE OF THE AMERICAS
NEW YORK, NY 100368403

EXAMINER
HU, SHOUXIANG

ART UNIT	PAPER NUMBER
2811	

DATE MAILED: 07/25/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Paper No. 27

Application Number: 09/292,186
Filing Date: April 15, 1999
Appellant(s): KINZER, DANIEL M.

Brendan J. Kennedy
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed on May 9, 2003.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The brief does not contain a statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief. Therefore, it is presumed that there are none. The Board, however, may exercise its discretion to require an explicit statement as to the existence of any related appeals and interferences.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is substantially correct.

(7) Grouping of Claims

The appellant's statement in the brief that certain claims do not stand or fall together is not agreed with because among the three independent claims (1, 4 and 9, respectively belong to Appellant's specified Groups I-III), claim 9 of Group III substantially comprises all the limitations recited in claims 1 of Group I and in claim 4 of Group II. Accordingly, all of the three groups will not be patentable if Group III is found not patentable.

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

US 6,090,716	Floyd et al.	07-2000
US 6,069,043	Floyd et al.	05-2000
US 5,674,766	Darwish et al.	10-1997

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 3-6, 8-13 and 20-22 are rejected under 35 U.S.C. 103(a) as being obvious over Floyd et al. ("Floyd'716"; 6,090,716).

Floyd'716 discloses a trench-type power MOSFET device (particularly see Figs. 1 and 10, and col. 2, lines 22-67), comprising: a vertical invertible channel composed of a first conductivity type (52; p type) between a heavily doped source region of a second conductivity type (50; n type) and a heavily doped drain region (or drain layer) of the second conductivity type (54; n type); a gate oxide (56); polysilicon trench gates of the second conductivity type (58A; n type), a source contact (66) in contact with the source region, wherein the layer of the channel material (i.e., a channel layer, or, a channel-forming layer) is an epitaxial layer and has a constant concentration along its full length (see Fig. 11).

In the embodiment of Figs. 1 and 10 in Floyd, the MOSFET device is an n-channel MOSFET (which normally has a source-channel-drain doping polarity of an n-p-n polarity type, i.e., with the first conductivity type being a p type and the second conductivity type being an n type). Although Floyd does not expressly disclose that the MOSFET device can also be a p-channel MOSFET (which normally has a p-n-p doping polarity), one of ordinary skill in the art would readily recognize that a MOSFET can be either an n-channel MOSFET or a p-channel MOSFET, and that a MOSFET design/structure which works under one polarity type is normally also workable under the reversed polarity, as evidenced in the prior art such as Floyd et al. ("Floyd'043"; US 6,069,043; see Figs. 3

and 11, and col. 7, lines 11-17) and Darwish et al. ("Darwish'766"; US 5,674,766; see col. 11, lines 20-22).

Therefore, it would have been well within the ordinary skilled in the art at the time the invention was made to make the MOSFET device of Floyd with the doping polarity being reversed, so that a MOSFET of desired p-channel type and improved circuit design flexibility (associated with the desired channel type) would be achieved.

Regarding claim 3, it is noted that silicon is the most widely used semiconductor material.

Regarding claims 4-6, 8-13, 21 and 22, the MOSFET device of Floyd with reversed polarity would inherently have a reduced on-resistance (when compared to the conventional p-channel MOSFET such as the one shown in Fig. 1 of the instant disclosure; the same type of comparison made in the instant disclosure, see the tables on pages 3 and 4 in the specification) and be bidirectional, as it would be basically identical to the structure of the instant invention and would not have any lightly doped drift layer between the channel-forming layer and the heavily doped drain layer.

Regarding claims 8, 11-13, although Floyd does not expressly disclose that the channel layer can have a resistivity of about 0.17 Ohm-cm and a thickness of about 2.5 um, and that the substrate has a resistivity less than 0.0005 Ohm-cm, it noted that these values are respectively well within the commonly recognized ranges for the relevant parameters, and that it is old and well known in the art the threshold voltage and the on-resistance of MOSFET are directly correlated to the doping concentrations of the channel layer and the substrate layer and the thickness of the channel layer; and they are all well

recognized parameters of importance subject to routine experimentation and optimization.

Therefore, it would have been obvious to one of ordinary skilled in the art at the time the invention was made to make the MOSFET device of Floyd with the doping polarity being p-n-p type, with the channel layer having a resistivity of about 0.17 Ohm-cm and a thickness of about 2.5 um and with the substrate having a resistivity less than 0.0005 Ohm-cm, through routine experimentation and optimization within the commonly recognized ranges for those parameters, so that a p-channel MOSFET with the desired threshold voltage and on-resistance would be achieved.

Regarding claims 6 and 20-21, it is noted that it is well known in the art that it is desirable to have a source electrode in direct contact with both of the heavily doped source region and the top region of the channel-forming layer through a heavily doped base region for improving the device stability, as evidenced in the prior art, such as in Fig. 12 of Floyd'043 and in Figs. 1,2 and 4 of Darwish'766.

(11) Response to Argument

Appellant's main arguments regarding the obviousness claim rejections include:

(A). Reversing the channel type of the MOSFET of Floyd'716 through the reverse of doping polarity to obtain the claimed invention is not obvious especially because the instant invention achieves unexpected results (throughout the argument section in the Brief).

(B). The instant invention has advantages that are not indicated or suggested in the cited prior art (particularly on page 6).

(C). The claimed invention could not be obtained through reversing the doping polarity of the MOSFET of Floyd'716 without undue experimentation (particularly on pages 6-9 in the Brief).

(D). The instant invention has achieved widespread commercial success (particularly on pages 11-13 in the Brief).

These arguments have been fully considered but they are not persuasive, as explained below.

In response to Arguments A and B above, appellant's arguments about the alleged "unexpected results" and "advantages" throughout the argument section in the Brief (especially on pages 6 and 7) appear to assert that the p-channel MOSFET of the claimed invention has achieved unexpected reduction in its on-resistance with respect to the n-channel MOSFET of Floyd'716, as one normally would have expected that the holes (in silicon) would have lower mobility than electrons. However, no evidence is found to support such an assertion, that is, there is no evidence to show that the p-channel MOSFET of the instant invention has achieved an on-resistance lower than that of the n-channel MOSFET of Floyd'716.

In fact, the alleged evidence (based on tables on pages 3 and 4 of the specification, as specified by appellant on page 6 in the Brief) for the alleged advantages of reduction in on-resistance is the results of a comparison made between

the p-channel MOSFET of the instant invention and a conventional p-channel MOSFET shown in Fig. 1 of the disclosure. Since the comparison is made between the two p-channel MOSFETS, the alleged results from the comparison are obviously unqualified to serve as a meaningful evidence for the assertion that the p-channel MOSFET of the claimed invention has achieved unexpected reduction in its on-resistance with respect to the n-channel MOSFET of Floyd'716; and the alleged results are also obviously unqualified to serve as a meaningful evidence to support the assertion that the p-channel MOSFET of the claimed invention has the advantages of reduced on-resistance over either the n-channel MOSFET of Floyd'716 or the p-channel MOSFET obtained through the doping polarity reversion of the n-channel MOSFET of Floyd'716.

Furthermore, it is noted that the results of reduction in on-resistance for the p-channel MOSFET of the instant invention (see the table on page 4 of the specification) with respect to the conventional p-channel MOSFET (see Fig. 1, and the table on page 3 of the specification) would be readily expected, instead of unexpected, by one of ordinary skill in the art at the time the invention was made. One of ordinary skill in the art would readily recognize that the removal of the lightly doped p-type drift layer in the conventional p-channel MOSFET shown in Fig. 1 (see the P^- drift layer therein) of the disclosure would predictably and naturally result in the reduction in the on-resistance, although it would also reduce the breakdown voltage, because the ordinary skill readily understood that, after the channel regions (in layer 22) being turned on in the conventional p-channel MOSFET, the lightly doped p-type drift layer would become the obvious main contributor to the on-resistance for the on-current flowing from the source

region (30) to the drain region (20) therein (also see applicant's admitted prior art in the bottom paragraph on page 3 of the specification).

On the other hand, a p-channel MOSFET obtained through the reverse of the doping polarity of the n-channel MOSFET of Floyd'716 would naturally have a reduced on-resistance, when compared with the conventional p-channel MOSFET having a lightly doped p type drift layer such as the one shown in Fig.1 of the disclosure, because the MOSFET design of Floyd'716 does not involve any lightly doped drift layer between the channel forming layer and the heavily doped drain layer.

Accordingly, appellant's arguments about the alleged "unexpected results" and "advantages" are found to be unsubstantial and not particularly relevant to the above obviousness claim rejections.

Regarding Argument C above, it is noted that "The fact that experimentation may be complex does not necessarily make it undue, if the art typically engages in such experimentation". *In re Certain Limited-Charge Cell Culture Microcarriers,* 221 USPQ 1165, 1174 (Int'l Trade Comm'n 1983). In this case, even if the alleged complexity associated with the reverse of polarity in a semiconductor device (particularly see pages 7 and 8 in the Brief, and the declaration by Ritu Sodhi as cited by appellant) did exist, it would not necessarily make it undue, because the art typically engages in such polarity-reverse experimentation. The prior art references of Floyd et al. ("Floyd'043"; US 6,069,043; see Figs. 3 and 11, and col. 7, lines 11-17) and Darwish et al. ("Darwish'766"; US 5,674,766; see col. 11, lines 20-22), as provided in the above obviousness claim

rejections, each sufficiently demonstrate the routine engagement of such polarity-reverse experimentation in the art. As evidenced in these references, and as even further evidenced in the declaration by Ritu Sodhi as cited by appellant and the applicant's admitted conventional p-channel MOSFET shown in Fig. 1 of the disclosure, it would be well within the ordinary skill in the art to form a p-channel MOSFET that normally comprises an n-type channel region disposed between p-type source and drain regions.

Therefore, forming a p-channel MOSFET of the claimed invention through reversing the doping polarity of the n-channel MOSFET in Floyd'716 would be well within the ordinary skill in the art as it would only involve routine engagement of polarity-reverse experimentation in the art.

In addition, with respect to appellant's alleged nonobviousness of the recited parameters in claims 8 and 11-13 (see page 10 in the Brief), a note taken by the examiner in the 3/4/02 Office action (Paper No. 19) stated that the doping concentrations of the channel layer and the substrate layer and the thickness of the channel layer are art-recognized results-effective parameters subject to routine experimentation and optimization; and that it would have been obvious to one of ordinary skilled in the art to make the MOSFET device of Floyd with the recited resistivity and/or thickness, so that the desired threshold voltage and the on-resistance of the MOSFET would be achieved. Since applicant did not seasonably traverse this note in his 9/9/02 response (Paper No. 23), the object of the note was then taken to be admitted prior art (see *In re Chevenard*, 139 F.2d 71, 60 USPQ 239 (CCPA 1943)) in the 12/03/02 Office action (Paper No. 24). It was further noted in the 12/03/02 Office

action (Paper No. 24) that the recited values for the doping concentrations and the thickness in claims 8 and 11-13 are respectively well within the commonly recognized ranges for the relevant parameters. Had the applicant seasonably and timely challenged any of those notes, relevant and detailed evidences would have been provided by the examiner.

Given the well-established and art-known basic relationships between the results of on-resistance and threshold voltage and the parameters of the resistivity and layer thickness, one of ordinary skill in the art would readily recognize that the resistivity and layer thickness are result-effect variables to the on-resistance and/or threshold voltage of a MOSFET, regardless it has an n-channel or p-channel. And, it would be well within the ordinary skill to obtain a set of optimal values for the resistivity and layer thickness such as the one recited in the rejected claims (claims 8 and 11-13) through routine experimentation and optimization within the art-recognized parameter ranges for the relevant result-effective variable in order to achieve desired on-resistance and/or threshold voltage, since it has been held that "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Regarding argument D, it is noted that when evidence of commercial success is submitted, examiners must evaluate it to determine whether there is objective evidence of success, and whether the success can be attributed to the ornamental design. An

affidavit or declaration under 37 CFR 1.132 has minimal evidentiary value on the issue of commercial success if there is no nexus or connection between the sales of the article in which the design is embodied and the ornamental features of the design. Avia Group Int 'l Inc. v. L.A. Gear, 853 F.2d 1557, 7 USPQ2d 1548 (Fed. Cir. 1988). In this case, although the clamed invention is not about an ornamental design and it might implies some process limitation as alleged by appellant, it is directed to a structure that is considered to be obvious and would be readily obtained through polarity reversion without undue experimentation, as discussed above. Moreover, it is noted that even if the implicated process limitations as alleged by appellant were directly recited in the claims, these process limitations would not carry patentable weight in the claims drawing to a structure, because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985). Furthermore, if significant process difficulties were indeed overcome in order to achieve the alleged commercial success, as asserted by appellant, then it should be the relevant process inventions, not the claimed structure, that should be considered to carry patentable weight in view of the commercial success.

Regarding Arguments A-D above, it is further noted that appellant disputes over examiner's statement that a MOSFET design which works under one polarity type is normally also workable under the reversed polarity, but fails to provide evidence to show how and why a p-channel version of MOSFET obtained through the polarity reversion of the n-channel MOSFET of Floyd'716 would not be workable. As explained in the claim

rejections above, the polarity reversion of the n-channel MOSFET of Floyd'716 would result in a p-channel MOSFET having a n-type-doped channel-forming layer disposed between and in direct contact with a heavily doped p-type source region and a heavily doped p-type drain region. The resulting p-channel MOSFET would be naturally workable as it possesses all of the key elements for a p-channel MOSFET. And, the resulting p-channel MOSFET would be fully and directly readable as the claimed MOSFET defined in claims 1 and 3. It would also be fully readable as the claimed MOSFET defined in claims 4-6, 9 and 10, in the sense that the resulting p-channel MOSFET would naturally have a reduced on-resistance when compared to a conventional p-channel MOSFET such as the one shown in Fig. 1 of the instant disclosure (the same type of comparison made in the instant disclosure, see the tables on pages 3 and 4 in the specification), because it would not involve any lightly doped drift region.

As also noted in the claim rejections above, one of ordinary skill in the art would readily recognize that a p-channel MOSFET would be more desirable than an n-channel one in certain applications since it would provide the channel type that would be more suitable for those applications and result in the circuit design flexibilities associated with the availability of the desired channel type. In addition to prior art references cited in the above claim rejections, the very existence of the conventional p-channel MOSFET admitted by the applicant in Fig. 1 of the disclosure not only further demonstrated the desirability of a p-channel MOSFET in the prior art, even though holes in silicon would have lower mobility than electrons, but also further manifested the level of the ordinary skill in the art with which a p-channel MOSFET would be readily formed.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make a p-channel MOSFET as defined in the claimed invention through reversing the doping polarity of the n-channel MOSFET in Floyd'716, as the one of ordinary skill in the art would readily recognize that such a p-channel MOSFET would be desirable and that such reversion would require only routine engagement of polarity-reverse experimentation.

In addition, it is also further noted that arguments made by applicant in the previous amendments and declaration had been fully considered, instead of repeatedly ignored as alleged by appellant, but found not persuasive in the respective previous Office actions.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Shouxiang Hu
July 7, 2003

Conferees of Appeal Conference:

Tom Thomas
SPE, AU 2811

Olik Chaudhuri
SPE, AU 2823

Shouxiang Hu
Examiner, AU 2811

Brendan J. Kennedy
OSTROLENK, FABER, GERB & SOFFEN, LLP
1180 Avenue of Americans
New York, New York 10036-8403